

Claims

- [c1] What is claimed is:
1. A method for optimizing a playout delay of packets being transmitted within a network, said packets comprising data for playout in a stream and compressed according to a codec, said network having a network delay of packet transmission, the method comprising:
 - (a) determining a loss mean opinion score (LMOS) of a previous packet according to the codec;
 - (b) calculating an estimated playout delay for a current packet based on the LMOS of the previous packet; and
 - (c) delaying playout of the current packet by the estimated playout delay.
 - [c2] 2. The method of claim 1 wherein in (a) a delay mean opinion score (DMOS) of the previous packet is also determined according to the codec, and in (b) the estimated playout delay for the current packet is calculated further based on the DMOS of the previous packet.
 - [c3] 3. The method of claim 2 further comprising:
 - (d) calculating a mean network delay variance of the current packet;
 - (e) determining a playout scaling factor; and
 wherein in (b) the estimated playout delay is calculated further based on the mean network delay variance of the current packet and the playout scaling factor.
 - [c4] 4. The method of claim 2 further comprising:
 - (f) calculating a plurality of other estimated playout delays for the current packet;
 - (g) calculating a mean mean opinion score (MMOS) of each estimated playout delay of the plurality of estimated playout delays; and
 - (h) selecting an estimated playout delay having an maximum MMOS from the plurality of estimated playout delays before performing (c).
 - [c5] 5. The method of claim 4 wherein the plurality of other estimated playout delays calculated in (f) comprises:
 - a playout delay of the previous packet;

a playout delay of the previous packet increased by a step size; and
a playout delay of the previous packet decreased by a step size.

- [c6] 6.The method of claim 4 wherein the calculated MMOS depends on a codec delay, the network delay, the estimated playout delay, and a packet loss rate.
- [c7] 7.The method of claim 6 wherein the MMOS is a measure of playout quality, and a high MMOS corresponds to a high playout quality.
- [c8] 8.The method of claim 1 wherein the packets contain audio or video information.
- [c9] 9.The method of claim 1 wherein the playout of the packets is for a voice over Internet protocol (VoIP), streaming audio, or streaming video application.
- [c10] 10.The method of claim 1 wherein the network is a computer network or a radio transmission network for wireless phones.
- [c11] 11.A playout device for playing data contained in packets with an optimized delay, said packets being transmitted within a network and comprising data for playout in a stream and compressed according to a codec, said network having a network delay of packet transmission, the playout device comprising:
a playout buffer for receiving and buffering packets;
a playout controller for determining estimated playout delays of packets from estimated network delays and codec information, and for controlling the playout buffer according to selected playout delays;
a network delay estimator for calculating estimated network delays of packets and sending estimated network delays to the playout controller; and
a codec detector for detecting the codec to which the packets are compressed and sending codec information to the playout controller.
- [c12] 12.The playout device of claim 11 further comprising:
a receiver through which the playout buffer receives packets from the network;
and
a media output device to which the playout buffer outputs packets.
- [c13] 13.The playout device of claim 11 wherein the codec detector provides codec

information that is sufficient for the playout controller to determine a loss mean opinion score (LMOS), a delay mean opinion score (DMOS), and a mean mean opinion score (MMOS) for packets.

[c14] 14.The playout device of claim 13 wherein the playout controller selects a playout delay for a current packet having a maximum MMOS from a plurality of estimated playout delays.

[c15] 15.The playout device of claim 14 wherein the plurality of estimated playout delays comprises:
a playout delay of a previous packet;
a playout delay of the previous packet increased by a step size;
a playout delay of the previous packet decreased by a step size;
a playout delay based on the LMOS of the previous packet, a mean network delay variance of the current packet and a playout scaling factor.

[c16] 16.The playout device of claim 15 wherein the playout delay is based on the LMOS of the previous packet, a mean network delay variance of the current packet and a playout scaling factor further depends on the MMOS of the previous packet.

[c17] 17.The playout device of claim 13 wherein the playout controller determines the MMOS of the current packet for each of the estimated playout delays referencing a codec delay, the network delay, the estimated playout delay, and a packet loss rate.

[c18] 18.The playout device of claim 11 wherein the network is a computer network or a radio transmission network for wireless phones.

[c19] 19.The playout device of claim 12 wherein the media output device is a voice over Internet protocol (VoIP) player, a streaming audio player, or a streaming video player.